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WMO

GAW

Empa
Materials Science and Technology

WCC-Empa activities improve data availability and data quality

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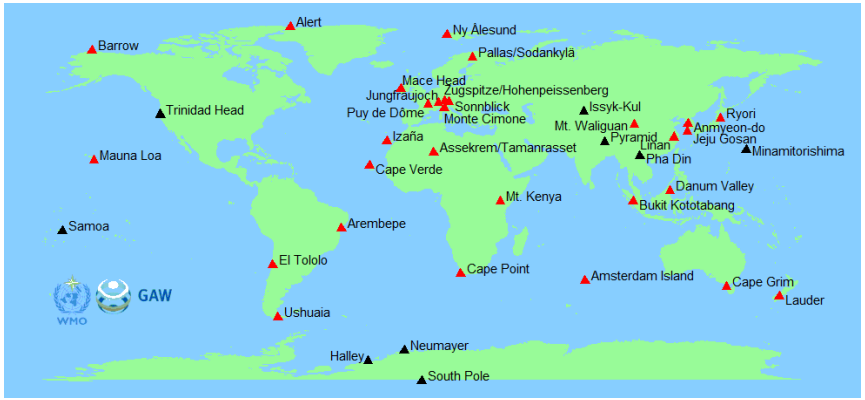
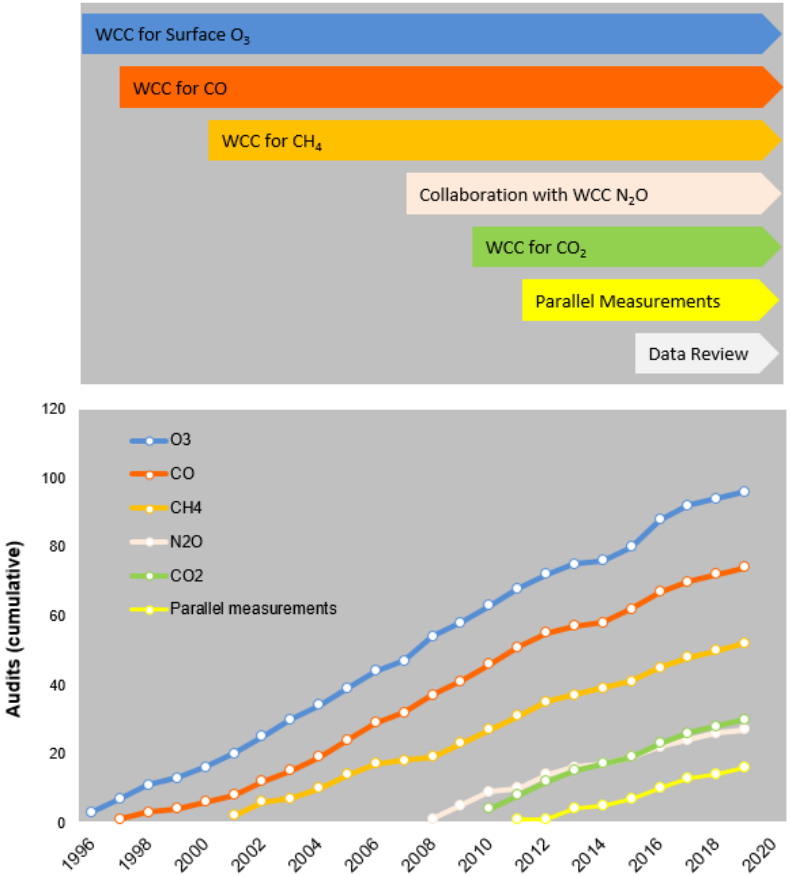
World Calibration Centre WCC-Empa

- Supports global research and policies since 1996
- More than 100 station audits at mainly global GAW stations
- Covers four important greenhouse and reactive gases
- Collaborates with other calibration centres to improve traceability
- Assesses the performance of stations also with parallel measurements
- Audit procedure includes data and metadata review

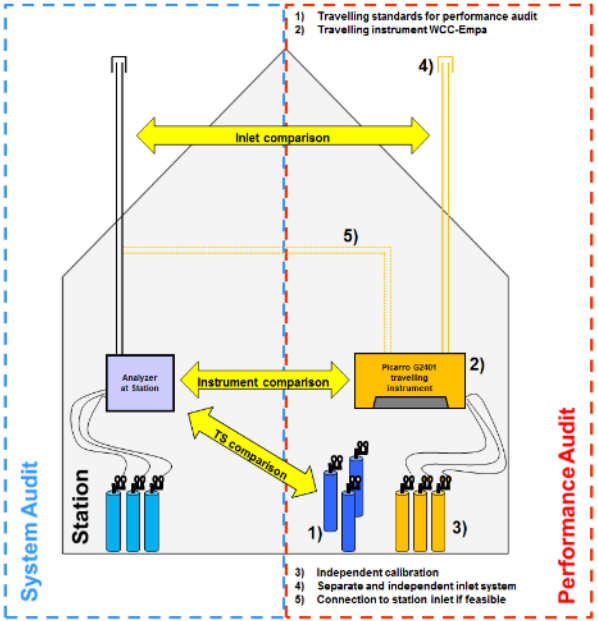


Audited stations by WCC-Empa since 1996 (red triangles)



Scope (top) and cumulative number (bottom) of WCC-Empa audits

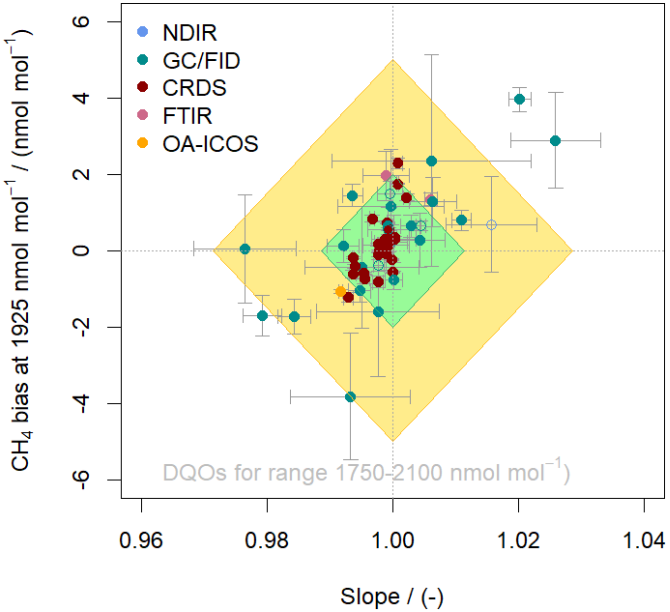
Audits: Travelling Standards vs. Parallel Measurements

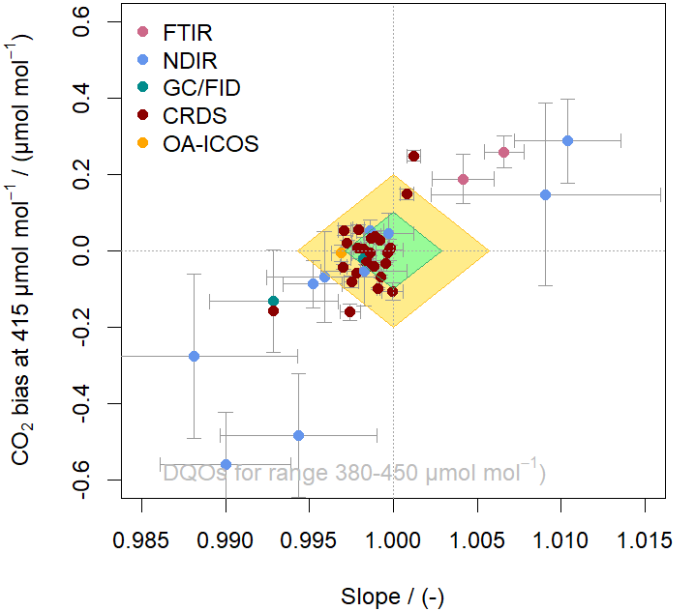


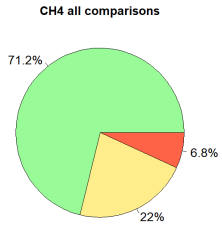
- 😐 Only instrument comparison
- 😐 Snapshot in time
- 😐 Special care might influence results
- ☺ Covers wider mole fraction range
- ☺ Repeatability conditions

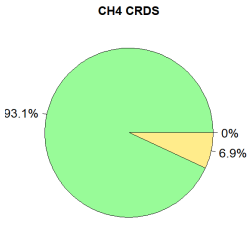
- ☺ Assessment of the whole system
- ☺ Longer time period
- ☺ Less influence by operator
- 😐 Limited to ambient mole fraction range

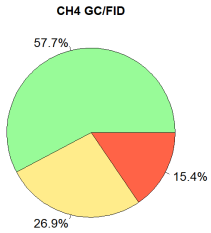
Results of CH_4 and CO_2 audits using travelling standards

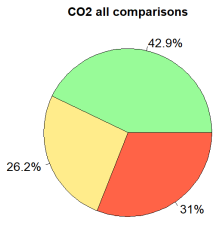


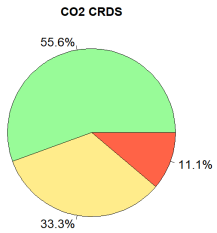


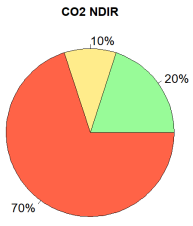








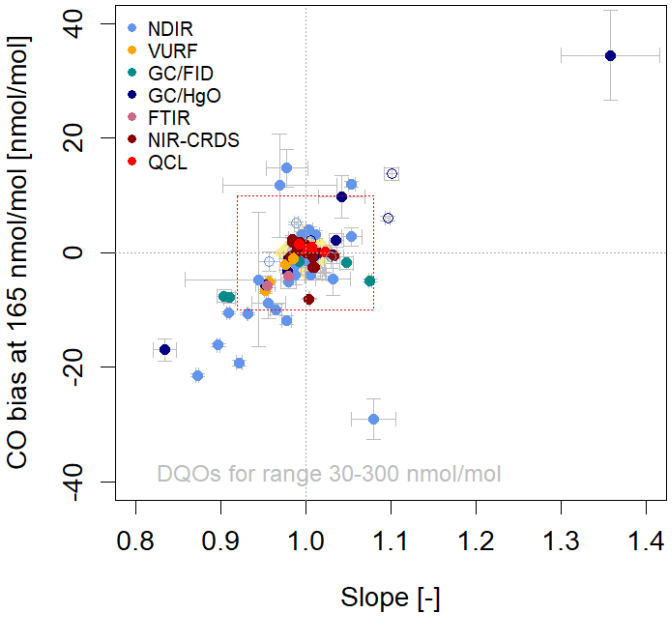


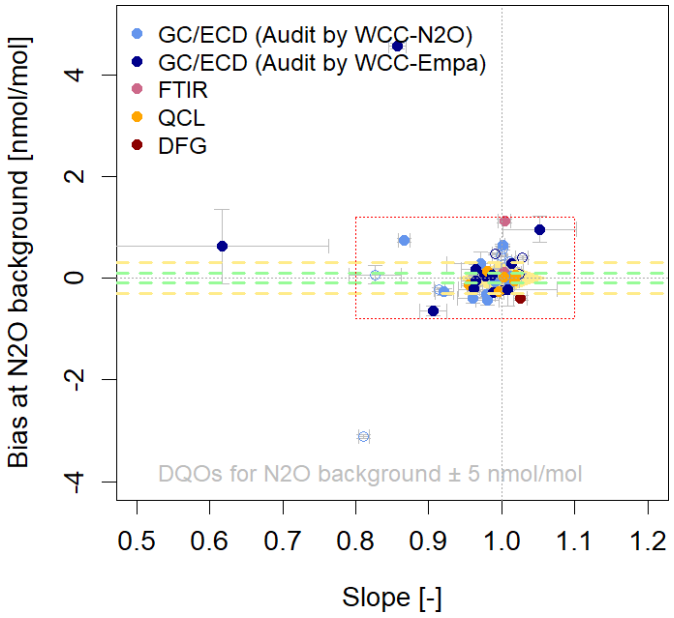


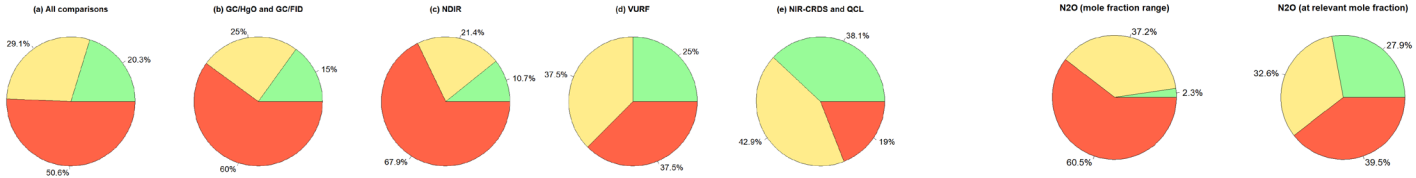
- Update from Zellweger et al. (2016).
- Newer techniques perform better compared to NDIR (CO_2) and GC/FID (CH_4).
- Comparisons shown here are only for
  - analyzers without instrumental problems and
  - Measurements on the same calibrations scale

Zellweger, C., et al.: amt-9-4737-2016, 2016.

Results of CO and N_2O audits using travelling standards



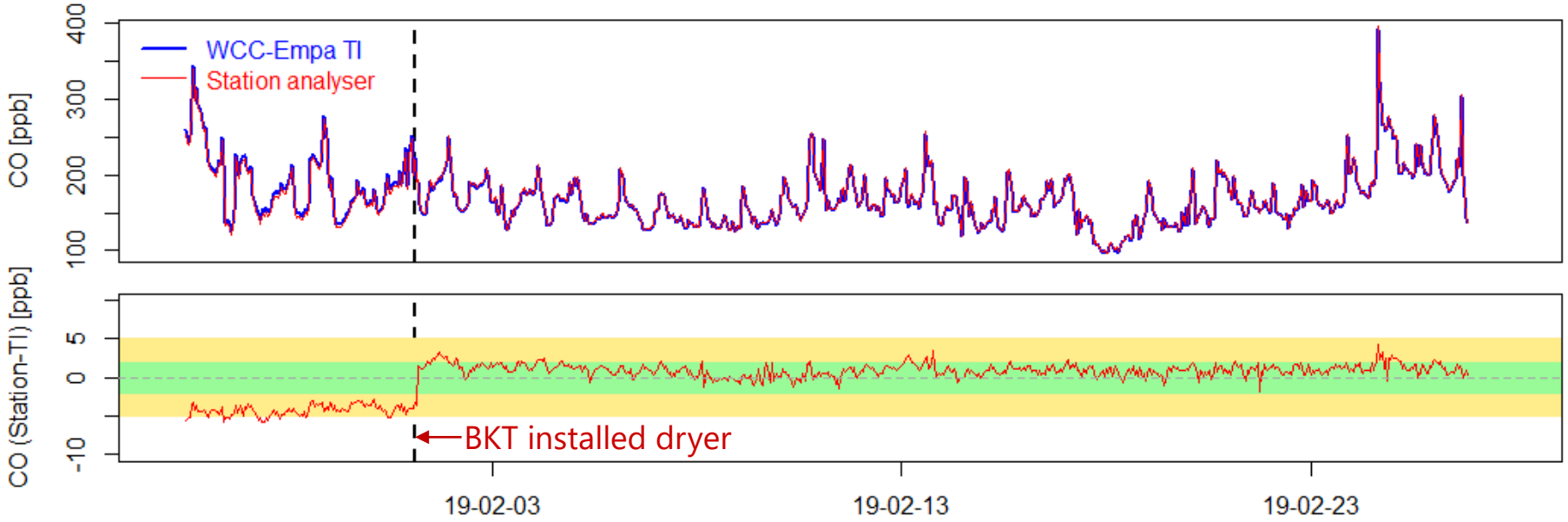




- Zellweger et al. (2019), including newer comparisons.
- CO and N_2O: Much more challenging to reach the WMO network compatibility goals.
- Newer spectroscopic instruments perform better compared to GC techniques.
- Only comparisons without instrumental problem are shown.

Zellweger, C., et al.: amt-2019-108, 2019.

Benefit of parallel measurements during audits



- Example: Parallel CO measurement @ Bukit Kototabang, Indonesia
- Dryer was installed after recommendation by WCC-Empa
- Results improved and were within compatibility goals

Audit reports are publicly available

GAW Report, 262/WCC-**Empa** Report No. 20/2. Research Infrastructure Quality Assurance – System and Performance audit of Surface Ozone, Carbon Monoxide, Methane, and Carbon Dioxide at the Global GAW Station Sonnblick, Austria, July 2020

World Meteorological Organization (WMO) - WMO, 2021

English

GAW Report, 258/WCC-**Empa** Report No. 18/2. System and Performance Audit of Surface Ozone, Carbon Monoxide, Methane, Carbon Dioxide and Nitrous Oxide at the Global GAW Station Mace Head, Ireland

World Meteorological Organization (WMO) ; November 2018 - WMO, 2020

English

- Audit reports are made publicly available as WMO/GAW reports
- Access to the reports is possible through WMO library (https://library.wmo.int/) or Empa GAW (www.empa.ch/gaw) websites
- Reports present and summarize all results of the system and performance audit
- Reports contain recommendations to sustain and improve the measurements and their quality

GAW stations audited by WCC-Empa (red triangles)

Achievements

Benefits of WCC-Empa audits include

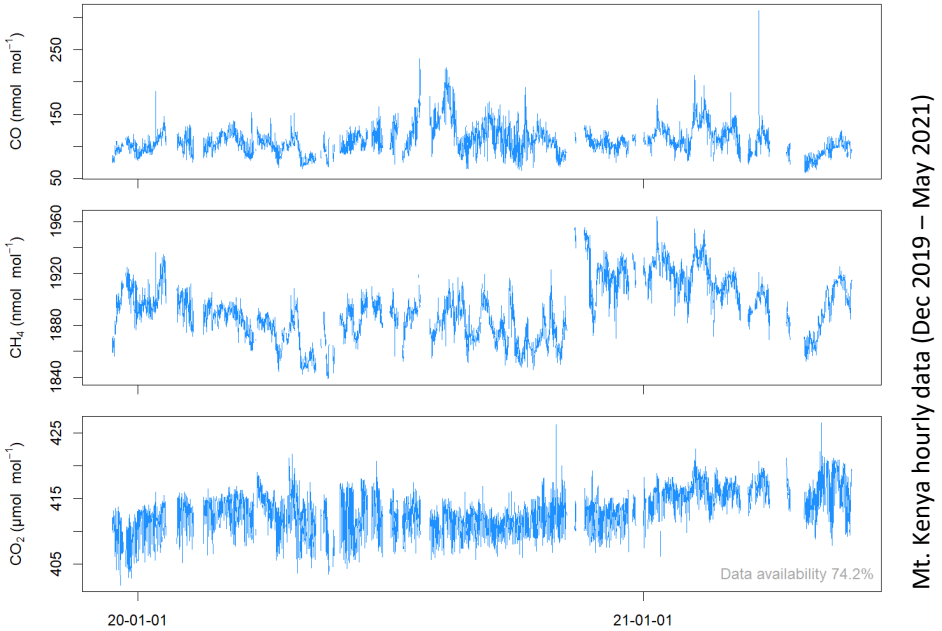
- Improved data quality
- Increased data availability
- Improved technical know-how of station operators
- Increased awareness and acceptance of the GAW programme

WCC-Empa **Audits**

- Alert - 2004
- Amsterdam Island - 2008
- Anmyeon-do - 2014, 2017
- Arembepe - 2001
- Assekrem - 2003, 2007, 2015
- Barrow - 2008
- Bukit Kototabang - 1999, 2001, 2004, 2007, 2008, 2011, 2014, 2019
- Cape Grim - 2002, 2016
- Cape Point - 1997, 1998, 2002, 2006, 2011, 2015
- Cape Verde - 2012
- Danum Valley - 2008, 2013
- El Tololo - 2017
- Hohenpeissenberg - 1997, 2006, 2011, 2020
- Izaña - 1996, 1998, 2000, 2004, 2009, 2013, 2019
- Jeju Gosan - 2017
- JMA - 2005
- Jungfraujoch - 1999, 2006, 2015
- Lauder - 2010, 2016
- Linan - 2016
- Mace Head - 1996, 1998, 2002, 2005, 2009, 2013, 2018
- Mauna Loa - 2003
- Mt. Cimone - 2012, 2018
- Mt. Kenya - 2000, 2002, 2005, 2006, 2008, 2010, 2015, 2019
- Mt. Waliguan - 2000, 2004, 2009, 2016
- Pallas - 1997, 2003, 2007, 2012
- Puy de Dôme - 2016
- Regional Calibration Centre for Surface Ozone Buenos Aires - 2010, 2017
- Ryori - 2005
- Sonnblick - 1998, 2020
- Ushuaia - 1998, 2003, 2008, 2016, 2019
- Zeppelin Mt. - 1997, 2001, 2005, 2012
- Zugspitze / Schneefernerhaus - 1996, 1997, 2001, 2006, 2011, 2020

Training and Twinning – Example Kenya

- Station established in the 1996.
- Initial phase was characterized by slow progress (issues with expertise, funding, power supply).
- First attempt to establish GHG measurements in 2010 failed, mainly due to damaged power line.
- Second attempt in 2019 successful.
- Data availability ~75% since then.
- Collaboration between KMD, WCC-Empa, QA/SAC Switzerland, MeteoSwiss, PSI (aerosols) with logistical support from WMO.
- Status now fully operational but fragile.
- Frequent changes of station staff (loss of knowledge).
- Ongoing effort by twinning partners needed to sustain operation at MKN.



Expert teams and memberships

World Calibration Centre WCC-Empa participates in several Expert Groups

- Scientific Advisory Group for Reactive Gases
- Expert Team on Atmospheric Composition Measurement Quality (ET-ACMQ).
- Expert Team on Measurement Uncertainty (ET-MU)
- CCQM-GAWG Task Group on Ozone Cross-Section Change Management (see also poster No. 11, Paul Brewer)

World Calibration Centre WCC-Empa contributes to

- GAW measurement guidelines.
- Recommendations on best practice, e.g. on *Low-cost Sensors for the Measurement of Atmospheric Composition (WMO- No. 1215, 2021)*

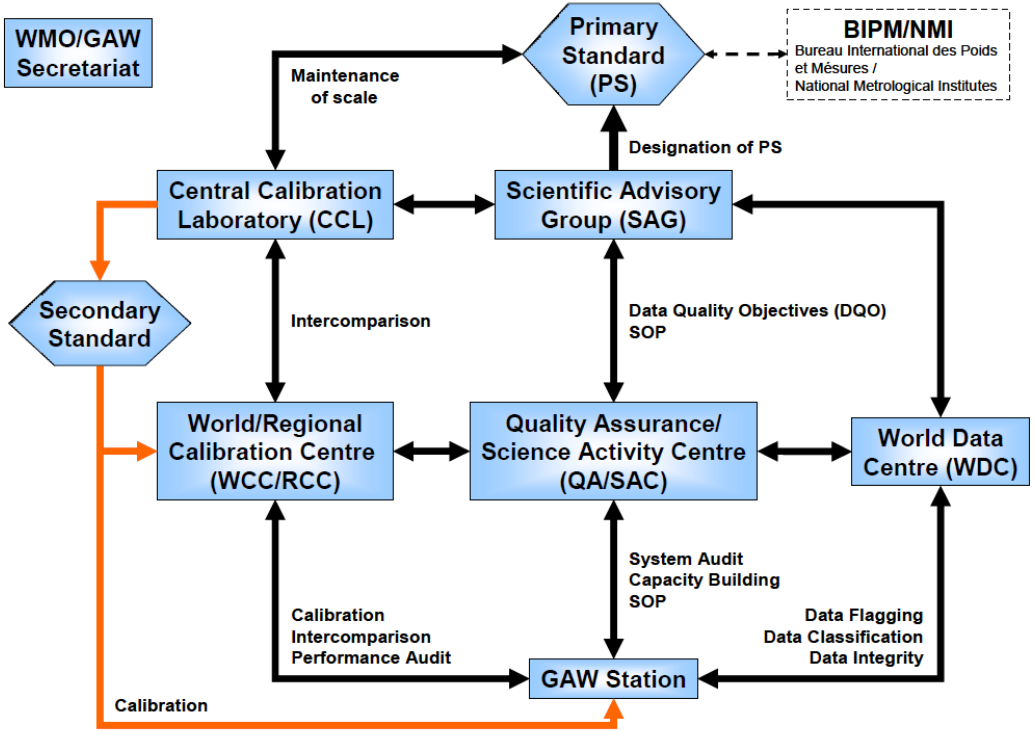


Figure 15 - Elements of the Quality Assurance system, QA activities and workflow in GAW

Acknowledgments

- Financial support of GAW activities by MeteoSwiss
- WCC-N_2O for data sharing and collaboration
- Staff at various GAW stations and Empa for their support